Efficacy of Tele-Endoscopy in a Rural Capitated Market

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Purpose: *To attempt to quantify the potential for success of tele-endoscopy as a component of the VTMEDNET Plus telemedicine implementation, a multi-part prospective study was undertaken by faculty of the Vermont Initiative for Rural Health Informatics and Telemedicine.* ***Method:*** *The study was comprised of three separate parts, evaluation of image quality, cost analysis, and identification of referring providers needs and attitudes regarding tele-endoscopy.* ***Findings:*** *The image quality was satisfactory to support remote diagnosis in most cases; there was significant cost savings in a managed care environment; referring providers were generally positive about the attributes of tele-endoscopy.* ***Conclusion:*** *Tele-endoscopy is a viable and cost-effective component within a telemedicine system.*

INTRODUCTION

Telemedicine was first marketed as a tool to mitigate perceived differences in the quality of health care delivery caused by distance and other issues of accessibility. While telemedicine pilot projects began in the late 1960's, very little interest in sustainable programs was generated outside of the military until the late 1980's and early 1990's when such diverse projects as the Kansas University Medical Center link to the Hays Medical Center, the MedNet Project of Texas Tech University, and the Medical College of Georgia telemedicine program were developed.[1]

Accessibility to quality health care is still a major driving force behind the proliferation of telemedicine projects, but other factors are now supporting the growth in use of telemedicine to deliver care. First, technology and telecommunications have improved to a point in which image quality and speed of transmission make the use of telemedicine for diagnosis and management of remote patients feasible. Second, patients are becoming more active participants in their own health care and factors such as referrals to a specialist which requires an excessive amount of travel time might mean loss of that patient to another provider. Third, while telemedicine consultation, for the most part, is still not reimbursable under Medicare, Medicaid, or by major third part payers, managed care is making its use more cost-effective.

Vermont and VTMEDNET Plus

Vermont is a perfect environment for telemedicine. According to several national measures, Vermont is the most rural state in the nation. Over two thirds of its citizens live in towns with a population of less than 2,500. Several of its counties have areas designated as medically underserved. It has fourteen hospitals although the vast majority have fewer than one hundred beds, with a bed census much lower. The state's only tertiary care center, Fletcher Allen Health Care (FAHC), is affiliated with the University of Vermont College of Medicine and serves an area covering much of Vermont and upper New York state, with only Burlington, population of 39,000, being considered as an urban center.

Although there are highly skilled primary health care providers located around the region, there is still relative isolation of a large part of the population, due to both distance and climate during a large part of the year. Easy access to medical care has been difficult for many patients and in terms of tertiary care almost impossible. To alleviate this, specialty physicians at Fletcher Allen Health Care, through alliances made with regional hospitals and clinics, often spend one to two days per week traveling to remote locations to see a relatively low number of patients. These trips, while essential to insuring the delivery of quality medical care in rural areas, are not cost-effective when factoring in travel time of the specialist. With increasing managed care, they are becoming harder to justify in terms of shrinking health care dollars.

Because of these factors, and the recent availability of ISDN connections throughout the entire service area, Fletcher Allen has embarked on an extensive and comprehensive telemedicine program called VTMEDNET Plus, predicated on the expansion of VTMEDNET, its earlier state-wide health information network.[2-3] The vision for the telemedicine component of the enhanced network defined a comprehensive system which would enable the delivery of a variety of care using both new and proven telecommunications technologies and based on a thorough evaluation of each new application [4]

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Endoscopy and Tele-Endoscopy

One of the most promising applications in the VTMEDNET Plus telemedicine initiative has been endoscopy. The instrumentation is based on fibreoptic technology which provides both light and viewing capabilities. This, combined with a CCD video chip, enables the transmission of the image to a television monitor and transforms the single view fibreoptic endoscope into a video endoscope which enhances color definition and field of vision.[5]

While gross endoscopy through the use of semi-flexible lens gastroscopes was introduced as a diagnostic procedure in the 1930's, the most dramatic improvement in endoscopic instrumentation came in 1976 with the introduction of flexible sigmoidoscopy. Use of endoscopic procedures in primary and even secondary care was relatively rare although the American Cancer Society had issued a guideline suggesting that deaths from colon cancer could be significantly reduced by early detection through performing routine sigmoidoscopies after the age of 50. However, prior to the introduction of the flexible sigmoidoscope, the procedure was considered by many physicians to be too difficult to perform in the office and too uncomfortable for patients. Many also felt they lacked the expertise to accurately diagnose suspected lesions.[6-8]

The need for primary care physicians to feel comfortable performing endoscopy within their office setting has created an opportunity for promoting tele-endoscopy, both in a managed care setting and in fee-for-service. It has also opened possibilities for support of rural gastroenterologists.

The instrumentation involved in performing a routine endoscopic procedure is identical to that needed for tele-endoscopy. Therefore, there is no learning curve on the part of either the referring gastroenterologists or the consulting providers, and the technology can support continuing education and mentoring of primary care providers. The telecommunications technology to transmit the images has been widely used and evaluated. However, there were no references in the literature through 1996 about the use of tele-endoscopy as a viable component of telemedicine supporting gastroenterology, and the only reference to the use of endoscopic procedures focused on otorhinolarygology.[9]

METHODS

In a recent article describing a staged approach to the evaluation of telemedicine, DeChant, et al, suggested that accuracy and reliability must first be assured before other forms of evaluation can take place. The second stage of the evaluation should include access, quality and cost.[10] To insure that tele-endoscopy was a viable component of VTMEDNET Plus, a similar staged evaluation process was undertaken, first assessing the diagnostic quality of the images and later looking at issues of cost and provider / patient satisfaction.

For the purposes of the first stage of the evaluation, an experimental design was used to evaluate the image quality based on review by endoscopists on staff at Fletcher Allen Health Care and members of the Internal Medicine Faculty at the University of Vermont College of Medicine. The second stage involved chart reviews and cost analysis for endoscopic referrals. The final area of evaluation involved interviews with the referring gastroenterologists as part of a needs assessment and solicitation of feedback for the project.

Although, ideally, the referring providers would be a mix of both rural gastroenterologists and primary care providers, for the purpose of the initial evaluation, referring providers were limited to rural gastroenterologists who routinely referred patients to Fletcher Allen Health Care for endoscopic consultations and who were interested in participating in the tele-endoscopy program.

Technology

Endoscopy at Fletcher Allen Health Care is performed using an Olympus GIF-100 video-endoscope and videoprocessor. For the purposes of tele-endoscopy, an external pan-tilt-zoom camera (Canon VC-C1 MK-II) serves as the primary camera source while a secondary camera is connected directly to the endoscopy system. Primary endoscopic images are captured using the image manager and Sony Mavigraph for viewing on a high-resolution 17" monitor.

The core telemedicine units are desktop video conferencing systems which use triple-ISDN Basic Rate Interface (BRI) lines providing a data transmission rate of 384 Kbps. Each unit is a 166 MHz PC equipped with 32 MB of RAM. HealthLink Networks, the system integrator, uses a Zydacron Z250 videoconferencing board and a Zydacron Z208 BRI inverse multiplexer card.

The Zydacron card can accept both an s-video and an ntsc signal. For the purposes of tele-endoscopy, s-video is used for the external camera connection and the ntsc connection for the endoscope. The software allows switching between the two sources. The

primary camera is used for face-to-face consultation between physicians and physicians or physicians and patients while the secondary input carries the endoscopic image.

Image Quality

Issues of image quality must be addressed in any telemedicine system. In tele-endoscopy, they are more complex because of the inherent variability in the reported findings on an endoscopic procedure. For instance, polyp size is a predictor of malignant potential. However, several studies indicated an error rate of over 25% for endoscopists without specifically targeted training or image processing.[11-13] For tele-endoscopy to be useful, the image appearing to the consulting gastroenterologist through video transmission must replicate the image actually seen by the endoscopist performing the procedure.

The evaluation protocol to determine the reliability of the tele-endoscopy procedure involved two physicians, either general surgeons or gastroenterologists, for each procedure. Both physicians were asked to record patient's name, probable diagnosis, degree of certainty, and quality of image. Interaction between the two was limited to a recitation of chief complaint by the physician performing the procedure prior to the initiation of the endoscopy and information pertinent to the referral.

The "gold standard" for the purposes of this part of the evaluation is the primary endoscopic image, against which the visual analog scale readings for video quality, mucosal and anatomic detail have been compared. The ability to make a diagnosis was compared on a case by case basis using information recorded by both the observer and the primary endoscopist using McNemar's test. Diagnostic certainty was evaluated using a paired t-test. Concordance of diagnoses between the endoscopist and the observer was analyzed using percent of agreement compared to expected inter-observer variability.

Cost-Effectiveness

The determination of whether or not tele-endoscopy is cost-effective would be very complex if capitation were not a basic premise in the determination. In using an example of reimbursement by Larimore and Zuber[14] for an endoscopic diagnostic procedure, reimbursement from Medicare for a colonoscopy examination in which both a biopsy of a small lesion and a polypectomy are performed could range from $306.59 to $510.17, depending on assignment of base procedure. Assuming the involvement of a consulting gastroenterologist using telemedicine, and assuming that such consultation was reimbursable, the scenario could be rewritten to pay the gastroenterologist for the basic diagnosis, the mentoring for the polypectomy, or even the gross reading of the pathology slide from the lesion if a digital camera was employed.

Capitation and use of tele-endoscopy assumes that procedure repetition by the consulting endoscopist is not necessary in many cases, thus reducing the overall health care system costs. To attempt to arrive at a dollar amount to attribute savings, random chart reviews enabled estimation of the number of patients referred for specific procedures from each of the rural sites. Based on this analysis, a determination of the actual costs of procedure repetition, which would not be necessary with access to the tele-endoscopy system, was made.

In addition, telecommunications costs were logged; equipment amortization was determined; a dollar amount was assigned to travel time of the endoscopist for routine procedures which required travel to the rural site; missed and rescheduled exams were averaged and assigned costs. Based on these numbers, actual gross savings of the use of the tele-endoscopy system were determined.

Needs and Satisfaction of Referring Providers

The implementation of any system to improve quality and access to health care is primarily dependent upon the buy-in of the health care providers participating in the system and the patients who are the beneficiaries of change.[15] For this reason, it is essential to determine the actual needs and expectations of the referring physicians and constantly monitor their satisfaction. Patient satisfaction is also imperative, especially in a managed care situation. However, for the purposes of this study, patient satisfaction was not evaluated.

To determine both the needs and the potential for satisfaction of the referring providers, semi-structured interviews, using both open-ended questions and a Likert-type questionnaire, were done following an analysis of referral patterns. The interviews were in large part based on the provider expectation and satisfaction interviews done as part of a telepathology pilot project completed as the initial phase of the VTMEDNET Plus initiative.[16]

RESULTS

Image Quality

Diagnostic concordance was considered the primary indicator that the tele-endoscopic image could

validate the system. Although the sample is relatively small, thirty patients, the diagnostic concordance is 100%. Diagnostic certainty among all gastroenterologists, regardless of assignment, revealed no statistical differences, inferring that the tele-endoscopic system provided enough visual quality to enable comparable diagnostic accuracy when compared to the image presented during the endoscopic procedure.

In analyzing the visual analog scores, however, the perceived visual quality of the tele-endoscopic images were ranked from nine to sixteen percent lower than the primary endoscopic images. The comparison between the two findings suggests that the image variability is not significant enough to prevent accurate diagnoses using tele-endoscopy.

Cost-Effectiveness

For the purpose of determining cost savings for the implementation of tele-endoscopy, records for endoscopic procedures and referral patterns were analyzed for a six month period. Three hundred four endoscopic procedures were done by specialists with referrals coming from the academic medical center, rural primary care providers, and fifteen rural general surgeons and gastroenterologists from both Vermont and upper New York state. The consulting endoscopists were all board certified and members of the faculty of Internal Medicine and Surgery at the University of Vermont.

One hundred one of the endoscopic procedures were Flexible Sigmoidoscopies, all of which could have been performed by trained primary care physicians at a cost of less than half the provider charge for the procedure done at the academic medical center. While tele-endoscopy does not directly impact on cost savings for this procedure, its availability as a tool to facilitate consulting or specialty mentoring might serve as a catalyst to encourage primary care providers to perform the procedure in their offices. The total physician cost savings, assuming the satisfactory performance of the procedure in the least costly site, would be $9,910.

The remaining 203 procedures fell into five general categories, all performed by referring gastroenterologists or general surgeons, Colonoscopies (31%), Esophagogastroduodenoscopy (EGD) (27%), Endoscopic Retrograde Cholangio-Pancreatography (ERCP) (13%), Liver Biopsies (12%), and Specialized Therapeutic Procedures (17%). Most of the ERCP procedures, all of the Liver Biopsies and all of the Specialized Therapeutic Procedures needed to be performed by trained specialists within the academic medical center setting.

Cost savings for the remaining procedures were divided into two groups. Forty-three percent of the Colonoscopies, 47% of the EGD's, and 6% of the ERCP's were performed twice, once by the referring provider and once by the consulting endoscopist. Using tele-endoscopy for immediate consultation would result in a gross provider cost savings of $44,438.

The second area of cost savings is in the ability of certain procedures to be performed at the site of the referring provider with concomitantly lower costs. Consulting endoscopists determined that 71% of the Colonoscopies and 66% of the EGD's did not need to be referred to the academic medical center if a tele-endoscopy system was in place. The consulting provider cost savings for doing endoscopic procedures at rural sites is $27,381.

Two additional costs to the academic medical would be reduced with the full implementation of tele-endoscopy. One of the consulting endoscopists travels to a rural site several times a month, at an average cost of $1,000 per month. The second cost relates to missed appointments, which are currently at 5% of all those scheduled. While it is virtually impossible to assign a dollar amount, 5% of the provider costs of the total scheduled procedures which might be impacted by tele-endoscopy represents $5,563.

Savings must be weighed against costs to determine whether any telemedicine program can be sustainable. Costs for the purpose of this evaluation include pro-rated telecommunications charges, computed for the targeted procedures based on anticipated contact hours and distance ($ 9,930), amortization of equipment ($4,775), and consulting endoscopist time ($9,625). For the six month period, the adjusted cost savings for use of tele-endoscopy in a managed care environment is $68,962.

Referring Provider Attitudes

Most referrals for endoscopic procedures which would be appropriate for tele-endoscopy come from the fifteen rural general surgeons and gastroenterologists practicing in Vermont and upper New York State. For the purpose of determining attitudes towards the tele-endoscopy initiative, two surgeons and two gastroenterologists were asked to respond to a set of questions. Four open-ended questions attempted to establish criteria for a routine consultation request and one using tele-endoscopy.

The referring providers were also asked to state levels of agreement with ten Likert-type scale statements, all dealing with the concept of tele-endoscopy and soliciting opinions on issues ranging from education and managed care to telemedicine law.

Based on responses, referring providers routinely seek consults if there is doubt about a diagnosis or lack of expertise in performing a procedure. Participation in the tele-endoscopy program and determination of its success centered on access, both for in terms of ease of access for the patient to specialists and on-demand availability of the tele-endoscopy encounter. Collegiality and a desire to avoid repetition of procedures were also positive factors.

Referring providers generally felt that tele-endoscopy would benefit patients, reduce costs of care, and enhance the quality of health care delivery. Feelings about educational benefits were mixed. Training, technical support, and patient confidentiality were significant issues which needed to be resolved before the program could be deemed successful. Reimbursement issues were not considered significant, however, the statement was made by referring providers rather than consultants.

CONCLUSION

Telemedicine is gaining in acceptance and viability, however many factors continue to make its widespread implementation difficult if not impossible, even in areas which appear to guarantee success. Evaluation of any telemedicine component or total system is essential and prospective evaluation of new applications enables organizations to make informed choices prior to the investment of significant time and resources. This was the rationale behind the efficacy of tele-endoscopy study.

The results of the multi-part study – satisfactory image quality, significant cost savings within a managed care environment, referring provider satisfaction – have lead to an accelerated deployment of tele-endoscopy as an integral part of the VTMEDNET Plus telemedicine initiative. Long-term evaluation is continuing, particularly in the areas of cost savings and provider acceptance.

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